# SECTION 550
# PORTLAND CEMENT CONCRETE PAVEMENT

## 550.01 DESCRIPTION.

This work consists of constructing a pavement composed of Portland Cement Concrete, with or without reinforcements as specified, on a prepared subgrade or base course.

## 550.02 MATERIALS.

A. **General.** Materials shall meet the following:

| Item | Section |
|---|---|
| Grouts and Mortar | 806 |
| Reinforcing Steel | 836 |
| Dowel Bars | 836 |

B. **Portland Cement Concrete.** Class AE Portland Cement Concrete pavement shall consist of virgin coarse aggregate, virgin fine aggregate, water, an air entrained agent, and Type I, IA, or II Portland Cement.

Material shall meet the requirements of Section 802.

C. **Joint Materials.**

1. **Concrete Joint Sealer.** The joint sealer shall be as shown on the Plans unless an alternate type is approved by the Engineer before use.

2. **Fillers and Sealant.** Materials shall meet the following:

| Item | Section |
|---|---|
| Preformed Expansion Joint Filler | 826.02 C |
| Preformed Expansion Joint Fillers (Bituminous type) | 826.02 D |
| Preformed Elastomeric Compression Joint Seal | 826.02 G |
| Hot-Poured Joint Sealant | 826.02 |
| Silicone Joint Sealant | 826.02 B |
| Backer Rod | 826.02 B1 |

## 550.03 EQUIPMENT.

Equipment shall meet the following:

| Item | Section |
|---|---|
| General | 151.01 |
| P.C.C. Equipment | 153 |

## 550.04 CONSTRUCTION REQUIREMENTS.

A. **General.** If a previously constructed lane of pavement is used as a side-form to support concrete finishing equipment, the pavement shall have been in place for 72 hours except when the ambient temperature is less than 40°F., then the pavement shall have reached a compressive strength of at least 3,000 psi before concrete shall be placed against it. If the previously constructed pavement is damaged during fine grading and paving operations, work shall be suspended until the cause of damage is corrected. Damaged pavement shall be replaced or satisfactorily repaired at the Contractor's expense.

The subgrade shall be prepared and maintained according to Section 230.02 B for the type shown on the Plans.

Base material shall be constructed and maintained according to Section 302.

B. **Fine Grading and Conditioning Roadbed.** The subgrade and base course shall be fine-graded to proper crown and elevation according to Section 230.02 B.3. The prepared grade shall be trimmed, compacted, and tested for proper section before concrete placement so paving operations may proceed without interruption. Excess material shall be removed and low areas filled with approved materials. Filled areas and areas loosened by the planer shall be recompacted before concrete placement. When use of the roadbed planer is impractical due to restricted access or work dimensions, the roadbed shall be trimmed and tested for proper section by other approved methods. Hauling and mixing equipment shall not operate on the finished grade except when the operation of this equipment off the finished grade is impractical due to restricted access. When the Engineer permits equipment to be operated on the finished grade, satisfactory arrangements shall be made for protection or repair of the roadbed. During concrete placement the roadbed shall be in a smooth, compacted condition, and shall be sufficiently moist to prevent absorption of water from the concrete. Roadbeds shall be kept moist without forming of mud or pools of water.

Maintenance, repair, and restoration of the treated subgrade and base course before placing the concrete pavement shall be at the Contractor's expense.

C. **Handling and Storing Materials.** Materials for concrete shall be handled and stored according to Section 802.04 A.

D. **Batching.** Batching of concrete materials shall be according to Section 802.04 B. Aggregates and bulk cement shall be proportioned by automatic batching equipment meeting Section 153.01 B.

E. **Measuring and Dispensing Admixtures.** Any admixture approved for use in the concrete mixture shall be measured and dispensed according to Section 802.04 C.

F. **Mixing and Transporting Concrete.** The concrete shall be mixed and transported according to Section 802.04 D and the additional requirements of this Section.

Mixers and hauling equipment shall not be operated on the roadbed except as provided in Section 550.04 B.

Mixers and hauling equipment shall not be operated on a newly-constructed pavement except as permitted by the Engineer and according to Section 550.04 O. Any fresh concrete spilled on the existing slab shall be promptly removed.

G. **Placing and Spreading Concrete.**

1. **General.** The concrete shall be deposited on the roadbed so segregation and unnecessary rehandling is avoided. Placement shall be continuous between all transverse joints. If concrete placement is temporarily interrupted, the unfinished face of the concrete shall be kept moist and protected against drying. When placement operations are resumed, the concrete shall be broken down and thoroughly consolidated with the fresh concrete. If the elapsed time between placement of successive batches or loads of concrete exceeds 45 minutes, a transverse construction joint shall be installed. Sections of pavement less than ten feet in length between joints will not be permitted.

   Concrete shall be deposited and spread so joint installations and reinforcement are not damaged or displaced.

   Spreading and initial strike-off shall be performed by a mechanical spreader meeting Section 153.07. Concrete shall be spread uniformly across the full width of the slab being paved, and shall be struck off at a height which provides a proper quantity of concrete for subsequent paving operations. Other methods of spreading may be approved by the Engineer where use of a mechanical spreader is not feasible.

   Immediately after the concrete is spread and struck off, it shall be thoroughly consolidated by full width vibratory equipment meeting Section 153.08. Approved portable vibratory equipment may be used where work dimensions or features do not permit use of full-width vibratory equipment.

   Over vibration, evidenced by segregation of material and excessive surface mortar, will not be permitted and vibration in excess of 4 seconds in any one spot will not be allowed.

   Continuous rumble strips shall be milled in both paved concrete shoulders, as shown in Standard Drawing. Rumble strips shall not be installed in the ramp area adjacent to the mainline. The Contractor shall establish rumble strip locations and spacing.

   Two-way radio contact communications shall be provided and maintained by the Contractor between the proportioning plant and the paving operation.

2. **Formed Paving.** The roadbed shall be prepared so the forms are adequately and uniformly supported for their entire length at the established grade.

   Side forms shall meet Section 153.04. The form sections shall be securely staked and free from play or movement in any direction.

   After staking, the grade shall be thoroughly tamped mechanically at both the inside and outside edges of the base of the forms.

   When in final position, the forms shall not deviate at any point by more than 1/8 inch from the established grade or by more than 1/2 inch from the estab-

lished alignment. Forms shall be set sufficiently in advance of placing concrete to provide time for the Engineer to check line and grade. The length of forms in place shall be equal to the anticipated linear feet of pavement to be placed in 2 hours. Forms which are disturbed or show evidence of an unstable foundation shall be reset.

3. **Slip Form Paving.**

   a. **Line and Grade.** The Department will set appropriate stakes for establishing the finished line and grade of the pavement. The Contractor shall erect and maintain the necessary taut lines for operating the automatic equipment and preserve the line and grade stakes set until the pavement is placed.

   b. **Placing Concrete.** When placing concrete pavement on a divided highway, the four-foot inside mainline shoulder and the two 12-foot driving lanes shall be placed in one continuous operation. Concrete shall be uniformly placed at a rate and consistency that produces a dense and homogeneous pavement with a minimum amount of manual finishing.

      Vibration shall be accomplished with vibrating tubes or arms working in the concrete, or with a vibrating screed operating on the surface of the concrete.

      The slip form paver shall be operated in a continuous forward movement. All concrete mixing, delivering, placing, and spreading operations shall be coordinated to provide a continuous and uniform forward movement without stopping and restarting the paver.

      If forward movement of the paver is stopped, all vibrating and tamping elements shall be stopped immediately.

H. **Placing Reinforcement.** Reinforcement, when specified, shall be installed according to details shown on the Plans. The reinforcing steel shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust which could impair the bond between the steel and concrete.

The reinforcement shall be positioned on approved supports in advance of the concrete placement or inserted in the plastic concrete by an approved mechanical device.

The Contractor shall verify the placement of reinforcement in the plastic concrete pavement. At minimum, the reinforcement location will be verified at the start of paving each day and at a frequency of every 500 feet during normal paving.

On projects with over 20,000 SY of concrete paving, the location of the reinforcement shall be verified by the use of a micro covermeter. The Contractor shall provide the micro covermeter and, at the request of the Engineer, allow the Department personnel to confirm bar locations with the micro covermeter.

The vertical and horizontal location of the reinforcement in the concrete shall be shown in the plans. If the reinforcement does not meet the requirements and tolerances specified for the placement of the reinforcement, corrective action shall be taken immediately and performed at the Contractor’s expense.

I. **Joints.**

1. **General.** Joints in concrete pavement shall be of the design specified and shall be constructed at the spacings and locations shown. The ramp joints beyond the ramp taper shall have the same spacing sequence as the mainline. The Contractor shall establish joint locations.

2. **Transverse Contraction Joints.** The contraction joints shall consist of weakened planes created by sawing on main line and shoulders, and by either sawing, inserting preformed inserts, or forming grooves in the pavement surface on small areas or tapers. The location of grooves to be formed or sawed shall be clearly and accurately marked on the plastic concrete surface by the Contractor. When specified, the contraction joints shall include a load transfer device.

   Sawed contraction joints shall be cut to the required dimensions with equipment meeting Section 153.12. The time and sequence of sawing shall be adjusted so all joints are cut before uncontrolled cracking occurs, and to permit sawing without excessive raveling. Joints shall be sawed within 24 hours to prevent uncontrolled cracking. Uncontrolled cracking that occurs shall be routed, cleaned and sealed according to Section 550.04 M.3 at the Contractor's expense. Immediately after sawing, the joint shall be flushed with water under sufficient pressure to remove residue left by the sawing operation. If an uncontrolled crack occurs within 5 feet of any proposed joint location before or during sawing, the joint shall be omitted and sawing of the joint discontinued. Any joint sawed within 5 feet of an uncontrolled crack shall be repaired at the Contractor's expense. When sawing is performed before removing side forms, the initial saw cut will extend to within 1/2 inch or less of the side forms. If the forms have been removed, the saw cut will be extended to the edges of the slab. Any curing media removed during sawing shall be immediately replaced.

   Before installing silicone sealant or preformed elastomeric compression joint seal, all joint grooves shall be inspected and spalls which are greater than 1/4 inch in depth shall be repaired by patching with an approved epoxy mortar meeting Section 806. Loose concrete shall be removed from the spalled area and the area shall be thoroughly cleaned. Heavy sheets of polyethylene, polyvinyl chloride, or other suitable material which do not bond to the epoxy shall be inserted in the joint groove to form the faces of the spalled patch. After cleaning, the spalled surface shall be primed with a brush application of epoxy binder, and an epoxy mortar of troweling consistency shall be placed in the spalled area and finished as the original pavement surface. The epoxy binder components shall be mixed in proportions and by methods recommended by the manufacturer. After the epoxy binder is thoroughly mixed, dry concrete sand shall be blended into the mixture to give an epoxy mortar of trowelable consistency. Patching of spalls shall be done only when the air and pavement temperature is above 40°F. Dry concrete sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured, the inserts shall be removed.

   Formed contraction joints shall be constructed by installing an approved preformed insert into the plastic concrete before final surface finishing. The inserts shall be vibrated into place or installed in a groove formed by a vibrating

cutter bar. The inserts top edges shall be flush with the concrete surface. Any voids, depressions, or ridges of concrete caused by installing inserts shall be filled or removed by hand-finishing methods, and the surface across the joint shall be straight-edged according to Section 550.04 J.5. The groove formed by the inserts shall be perpendicular to the pavement surface, true to the required alignment, and continuous along the full length of the joint. Inserts, except those designed to remain, shall be removed without damage to adjacent concrete.

When specified for use with the transverse contraction joint the dowel bars shall be held in the specified position parallel to the slab surface and to the centerline within a tolerance of 1/8 inch per foot vertically and horizontally. The dowel bar assembly shall be an approved metal supporting device securely staked to the roadbed and shall hold the dowel bars at the correct spacing, alignment and elevation. The position of the load transfer units shall be accurately marked with steel pins, or other precise methods, to locate the transverse joint over the center of the dowels. After the dowel bar assembly is staked to the roadbed and the dowel bars are held firmly in place, the assembly ties running parallel to the dowel bars shall be removed to allow for free movement of the dowel bars.

A thin uniform coat of multipurpose lithium grease, NLGI Grade #2, shall be used as the release agent. The release agent shall be applied to the entire length of the dowel bars within two hours of being covered with concrete.

3. **Transverse Expansion Joints.** The expansion joints shall be formed by installing preformed expansion joint filler at designated locations.

Dowel bars shall be installed in the expansion joint to act as a load transfer device. The dowels shall be held in the specified position parallel to the slab surface and centerline by a metal supporting device securely staked to the roadbed and shall hold the dowel bars at the correct spacing, alignment, and elevation. The dowel bars shall be placed within a tolerance of 1/8 inch per foot vertically and horizontally. The “free” half of each dowel shall be coated with a thin uniform coat of multipurpose lithium grease, NLGI Grade #2, as the release agent, and covered with a metal or plastic dowel cap or sleeve. The caps or sleeves shall fit the dowel bars tightly and the closed end shall be watertight. After the dowel bar assembly is staked to the roadbed and the dowel bars are held firmly in place, the assembly ties running parallel to the dowel bars shall be removed to allow for free movement of the dowel bars.

Preformed expansion joint filler shall be of the dimensions shown on the Plans and shall extend across the full width and depth of the slab at each transverse expansion joint. Filler shall be furnished in individual sections having a length equal to the pavement slab width being poured. Filler shall be accurately prepunched to fit snugly around the dowels.

The expansion joint assembly shall be securely staked to the subgrade. Unless the preformed filler is adequately supported by a load transfer assembly or other device designed to remain in the pavement, a suitable installing bar or header shall be used to support filler during placement and finishing of adjacent concrete. Filler shall be installed perpendicular to the pavement surface and true to the designated line of the joint. Where more than one section

of filler is permitted, abutting ends of individual sections of filler shall be neatly and securely jointed without any gap or offset between sections. The bottom edge of filler shall extend to or slightly below the bottom of the pavement. The top edge of filler shall be approximately 1/2 inch below the pavement surface. During placement and finishing of adjacent concrete, the top edge of filler shall be protected by a removable channel cap having flanges not less than 1 1/2 inches deep. An aluminum channel cap shall not be used.

Installation of the expansion joint assembly shall be approved before any concrete is placed against the joint. Equal pressure shall be maintained against both sides of the preformed filler as the concrete is placed, and an approved internal vibrator shall be used to consolidate the concrete on each side of the joint. After the concrete has been placed and finished, the protective channel cap shall be removed, the top edge of the filler shall be exposed over its full width and length, and the concrete on each side of the joint shall be edged to the specified radius. After the side forms have been removed, any concrete which flowed around the ends of the joint shall be removed to expose the full thickness and height of the filler.

The expansion joint shall be sealed with a low modulus silicone sealant meeting Section 826.02 B. All materials and installation methods shall meet Section 550.04 M.3.

At structures projecting through, into, or against the pavement, expansion joints of a preformed or poured type shall be constructed as specified.

4. **Transverse Construction Joints.** A transverse construction joint shall be installed at the end of each day's pour and whenever the elapsed time between placement of successive batches or loads of concrete exceeds 45 minutes. Transverse construction joints shall be installed halfway between two normally spaced transverse joints.

   The transverse construction joint shall be formed by installing an approved dowel splicer bar basket assembly. The dowel splicer bar assembly shall hold the dowel splicer bars parallel to the centerline and slab surface. The dowel splicer bars shall be placed within a tolerance of 1/8 inch per foot vertically and horizontally.

   The dowel splicer basket assembly shall be staked perpendicular to the centerline and marked. The Contractor shall pave over the assembly far enough to maintain the elevation of the top of the slab. A full depth saw cut shall be made to expose the dowel splicer bar, the excess concrete shall be disposed of and the threaded dowel extension bar shall be installed.

   After the adjacent slab is placed the construction joint shall be sawed and sealed as specified.

   On shoulders or urban projects where the Engineer determines it is not feasible to install a dowel splicer bar basket assembly the transverse construction joint shall be formed by installing an approved header shaped to conform to the cross-section of the slab being placed. The header shall be rigid and secured to prevent bulging or displacement while adjacent concrete is being placed and finished. The face of the header in contact with the concrete shall

be perpendicular to the pavement surface and shall be at right angles to the pavement centerline. A two piece or other approved header shall be designed to accommodate proper placement of any dowel bars or reinforcement extending across the joint and to allow removal without damage to the concrete.

The concrete adjacent to the header shall be thoroughly consolidated by an internal vibrator or other approved methods. Segregated or improperly consolidated concrete shall be removed. After the pavement has been finished, the surface adjacent to the header shall be edged to the specified radius.

5. **Longitudinal Weakened-Plane Joints.** Planes of weakness for longitudinal joints shall be created by sawing grooves in the pavement surface. Grooves shall be sawed to meet dimensions shown and shall be true to the required alignment of the joint.

   Equipment for sawing longitudinal joints shall meet Section 153.12. As sawing progresses, the joint shall be immediately flushed with water under sufficient pressure to remove residue left by the sawing operation. If sawing is performed before expiration of the required curing period, any curing media removed shall be immediately replaced after flushing. Sawing of longitudinal joints shall be completed within 7 days after concrete placement. Any uncontrolled cracking that occurs shall be routed, cleaned and sealed according to Section 550.04 M.3.

6. **Longitudinal Construction Joints.** The longitudinal joint between adjoining, separately constructed lanes of pavement shall be constructed as shown on the Plans. Tie bars across longitudinal construction joints shall be at the locations, spacing, and depth shown. Tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed. The bars may be inserted through small, accurately positioned holes in the side forms; approved 2-piece connectors may also be used.

J. **Finishing Concrete.**

1. **Sequence.** After concrete has been placed, spread, and vibrated according to Section 550.04 G, the sequence of finishing operations shall be screeding, floating if required, straight edging, final surface finishing, and edging at forms and joints.

2. **Use of Water.** When weather conditions cause rapid drying of the pavement surface a fine mist or fog spray shall be applied to the concrete surface for interim curing. Use of brushes to apply water and use of water to facilitate finishing will not be permitted.

3. **Screeding.**

   a. **Slip Form Paving.** When the concrete is placed with a slip form paver, the screeding shall be done by the paver.

   b. **Other Paving Methods.** Machine methods shall be employed to screed and consolidate the concrete, except where the Engineer determines the use of machine methods is not feasible. If the screeding machine breaks

down the concrete that was mixed at the time of breakdown, may be manually screeded provided the final product meets specified requirements. If the finished work is unsatisfactory, it shall be repaired or removed and replaced at the Contractor's expense.

Transverse screeding machines meeting Section 153.09 shall be operated over each area of pavement as many times as necessary to produce a surface having a uniform texture meeting the required crown and gradient. Each section of pavement shall be finished by 2 transverse screeding machines operating simultaneously. The forward speed of the screeding machines shall be coordinated with the rate of concrete placement to avoid frequent or unnecessary stops in the final screeding movement. The screeds shall be adjusted so a small quantity of concrete or mortar is carried ahead of each screed. Screeds shall be operated to avoid displacing or damaging joint installations. Segregated concrete or mortar carried ahead of the screeds shall not be deposited on or adjacent to any joint. If concrete is placed at a rate of less than 250 feet per hour one screeding machine may be used provided results are satisfactory and the screeding machine is operated at least twice over each area of pavement.

4. **Floating.** Long-handled floats, having blades at least 5 feet in length and 6 inches in width, may be used to smooth and fill in open-textured areas of pavement.

5. **Straightedging.** While the concrete is still plastic, the Contractor shall test the slab surface for trueness with a 10-foot straightedge meeting Section 153.10 B. The straightedge shall be placed parallel to the pavement centerline and shall be passed over the slab to reveal any high areas or depressions. High areas shall be struck off and low areas shall be filled with fresh concrete. The areas corrected shall be consolidated and refinished with a long-handled float. Hand floats shall be operated across the pavement by starting at the edge and slowly moving to the crown and back again to the edge. The float shall then be moved forward and the operation repeated. Only enough floating shall be done to seal the surface and care shall be taken to preserve the required cross section of the pavement. The surface shall be checked again with a 10-foot straightedge and any irregularities eliminated. Surplus water or laitance on the pavement surface shall be wasted outside the forms. Successive advances of the straightedge along the pavement shall lap the previously straightedged area by not less than 1/2 the length of the straightedge. Special attention shall be given to assure the surface across joints meets requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is free from observable depression below the straightedge, and the slab conforms to the required grade and cross section.

6. **Final Surface Finish.** After surface irregularities have been removed and before the concrete attains an initial set, a seamless strip of stiff-fiber artificial grass carpet shall be dragged longitudinally along the full width of the pavement. The surface texture shall be uniformly roughened leaving corrugations in the surface that are uniform in appearance. The width of material in the drag shall be in contact with the full width of the pavement. The drag shall be operated off of a string-line with its leading edge attached to a bridge riding on the forms or adjacent slabs. The drag shall be maintained clean and free

from encrusted mortar. A drag that can not be cleaned shall be replaced with new fabric.

Immediately following the grass carpet drag, the surface shall be given a transverse metal tine finish. The tining device shall consist of a single row of tines capable of producing grooves at groove widths with the following spacing (in inches): 2 1/4, 2 13/16, 1 1/8, 2 5/16, 2, 1 1/8, 1 1/16, 15/16, 1 3/16, 1, 2 3/16, 2 3/8, 2 3/4, 2 5/8, 1, 2 5/8, 2, 1 13/16, 11/16, 3/4, 2 1/2, 2 15/16, 2 15/16, 13/16, 1/2, 1/2, 1 1/2, 2 3/16, 7/8, 1 1/8, 1 7/16, 2 13/16, 1, 1 7/8, 2 1/16, 1 7/8, 2 3/4, 7/8, 2 5/8, 3/4, 1 3/4, 1/2, 2 3/16, 1 3/4, 2 3/8, 1 1/4, 2 1/16, 1 1/4, 13/16, 3/4, 1 9/16, 7/16, 1 5/8, 2 3/4, 2 7/8, 1 1/2, 1 1/2, 3/4, 1/2, 1/2, 2 11/16, 1 1/2, 2 5/16, 3/4, 1 1/8, 9/16, 2 5/8, 2 3/16, 1. The tining device shall place the tines at a skew of 1:6 left hand forward. The groove will be from 1/16" to 1/8" in depth. The texturing equipment shall be self-propelled and mechanically operated.

7. **Imprinting Pavement.** After texturing, the survey station numbers shall be imprinted into the surface by the Contractor about one foot from the edge of the pavement so the numbers can be read in the direction of traffic driving on the outside shoulder. On 2-way roadways, the station numbers shall be imprinted in the direction of stationing. In addition at the beginning and end of each day's pour, the station number to the nearest foot shall be placed at the right edge of slab.

   The month, day, and year shall be imprinted at the beginning and end of each day's pour near the edge of the slab opposite that used for stationing so the numbers can be read in the direction of the pour.

   The Contractor shall furnish devices for imprinting the pavement. The numerals shall be 3 to 4 inches in height and at least 1/4 inch in depth.

K. **Curing Concrete.**

1. **General.** Curing shall be accomplished using a wetted fabric cure or an impervious membrane cure. Any specified method of cure may be used but methods shall not be changed without approval. All concrete pavement shall be cured for a period of at least 72 hours unless high-early strength concrete is utilized. Curing may be suspended for high-early strength concrete when the pavement has attained the minimum strength specified in Section 550.04 O. for opening pavement to public traffic. Curing shall begin as soon as the curing cover can be placed without marring the concrete. If hair-cracking develops before placing the curing cover, curing procedures shall be modified to prevent loss of moisture by utilizing a fog spray of water or a wetted fabric. If hair-cracking continues, concrete placing and mixing shall be suspended until a solution has been found. Failure to provide (a) sufficient cover material of the type specified or (b) the interim cure utilizing a moist fog or moist fabric, will be cause for immediate suspension of concreting operations. No pavement shall be left exposed more than 30 minutes without the applied final cure.

2. **Wetted Fabric Cure.** This method of curing consists of covering pavement with wet mats of cotton, burlap, geotextile fabric, or other approved highly-absorptive fabric. Mats shall be placed to cover the entire pavement surface

and, the exposed sides of the pavement when the forms are removed. Fabric mats shall be kept wet to maintain free water on the pavement surface continuously during the curing period. The fabric mats shall remain in position for at least 72 hours, or after 12 hours if the mats are replaced with impervious membrane.

3. **Liquid Membrane Cure.**

   a. **General.** A uniform film of an impervious, type 2, white pigmented, membrane cure shall be sprayed over the surface immediately after the free water from the final surface finishing has left the surface. The curing compound shall be thoroughly mixed and applied with spraying equipment meeting Section 153.11. Curing cover that is damaged within the curing period shall be immediately recoated. If side forms are removed before expiration of the curing period, the exposed sides of the pavement shall be immediately sprayed with curing compound at the rate specified for the pavement surface.

   b. **Application.** The impervious compound shall be applied to the pavement surface in one or 2 applications. If 2 applications are utilized, the second application shall be made within 30 minutes of the first application. The total rate of application shall be at least one gallon per 150 square feet of pavement. Joints requiring sealing shall be protected against entry of curing compound.

L. **Removing Forms.** Side forms shall remain in place for at least 8 hours, and until the concrete has hardened to the extent that the forms can be removed without damage to the concrete. Pry bars shall not be used against any new pavement to remove forms. Any pavement damage resulting from form removal or use of form pullers shall be repaired at the Contractor's expense.

Before applying curing compound, honeycombed areas in the sides of the pavement or curb shall be repaired using freshly mixed mortar of the same proportions of cement and sand as used in the pavement concrete. If honeycombing occurs frequently, adjustments shall be made in the placement methods, including additional vibration at the form lines if directed by the Engineer.

M. **Sealing Joints and Cracks.**

1. **General.** Within 10 days after concrete placement and before opening the pavement to public or construction traffic, the joints shall be sealed with specified joint material. Before sealing, each joint shall be thoroughly cleaned of all dust, dirt, concrete scale, and other foreign matter and blown out with a jet of compressed air. The joint faces shall be clean and dry when the joints are sealed. Joints shall not be sealed when the air temperature is below 40°F.

   Uncontrolled relief cracks which extend across the full width of a non-reinforced pavement or which occur at the location of a doweled joint in reinforced pavement shall be routed, cleaned, and sealed with an approved joint sealer at the Contractor's expense.

   When the asphalt shoulder joint is to be sealed, the edge of the P.C.C. pavement shall form one vertical side of this joint and shall be cleaned by a device

which results in a smooth clean surface. The vertical face of the joint in the asphalt surfacing shall be smooth and vertical, and the line of its edge shall be straight and parallel to the edge of the P.C.C. pavement. The bottom of this joint shall be smooth and level.

2. **Hot Poured Elastic-Type Joint Seal Installation.** The joint shall be filled with an applicator meeting Section 153.13 B. from the bottom up to the required depth.

3. **Silicone Joint Sealant Installation.**

   a. **Cleaning Joints.** Joints shall be sawed and blown out with compressed air.

      Before installing silicone sealant, the vertical joint faces shall be cleaned by sandblasting. Oil, asphalt, curing compound, paint, rust, and other foreign materials shall be completely removed. The joint shall be blown out with compressed air immediately before installing silicone sealant. All incompressible materials shall be removed from the joint slot.

   b. **Backer Rod Installation.** Backer Rod shall be installed in transverse joints in a manner and at a location that produces the shape factor (width and depth) for the sealant specified.

   c. **Joint Sealer Application.** The joint sealer shall be applied by an approved mechanical device.

      Sealant shall be applied from inside the joint and squeezed against the sides of the joint to provide good adhesion. Sealant surface shall be tooled to produce a slightly concaved surface approximately 1/4 inch below the pavement surface. Sealants that are not self leveling shall be tooled before a skin forms on the surface. Soap or oil shall not be used as a tooling aid.

      Failure of the joint material in either adhesion or cohesion in the first year, will be cause for rejection. Repair shall be at the Contractor’s expense.

4. **Preformed Elastomeric Compression Joint Seal.** Immediately before installation of the preformed joint seal, joint grooves shall be thoroughly cleaned of all foreign material using a jet of compressed air at a working pressure of at least 90 psi. The lubricant-adhesion shall be applied to the joint groove walls or to the preformed joint seal or both. The preformed compression joint seal shall be installed by suitable machine tools. On ramps or locations where machine tools would not be practical, hand tools may be used. The seal shall be installed not less than 1/8 inch or more than 1/4 inch below the pavement surface and shall be free from curling or twisting in the joint groove.

   Joints having a length of 24 feet or less shall not contain any splice of the joint seal. Joints having a length over 24 feet shall not have more than 2 splices of the joint seal. The preformed joint seal shall extend one inch beyond each edge of the concrete pavement, and stretching of the preformed joint seal more than 5% is not permitted.

N. **Protection of Pavement.** The newly-placed concrete shall be protected from traffic by employing watch persons, if necessary, and by the erection and maintenance of barricades, fences, warning signs and lights, pavement bridges, and cross-overs.

When the temperature is expected to fall below 35°F., suitable measures shall be taken to maintain the concrete surface temperature above 40°F. for 5 days. Admixtures for curing or temperature control shall be used only as permitted or directed. The admixtures shall not be considered as a substitute for any specified curing requirement.

Any concrete pavement damaged before final acceptance, including damage by frost action, shall be repaired or removed and replaced at the Contractor's expense.

When bituminous material is applied adjacent to P.C.C. pavement, the adjacent P.C.C. pavement shall be protected from spills and smears. Discolored P.C.C. pavement shall be cleaned at the Contractor's expense. The P.C.C. pavement shall not be used to stockpile, mix, or dry bituminous mixtures.

O. **Opening to Traffic.** Newly constructed concrete pavement shall not be opened to public or construction traffic until all joints have been sealed. Pavement shall not be opened to public traffic or hauling equipment until the concrete has been in place at least 7 days (48 hours if it is high-early strength concrete), and the concrete has attained a flexural strength of at least 500 psi or a compressive strength of 3,000 psi. Specimen beams and cylinders used for testing shall be cured under the same conditions as the concrete pavement or cores may be taken from the pavement. Pavement that has not reached the required flexural and compressive strengths shall not be opened to public traffic or hauling equipment until it has aged at least 14 days.

P. **Tolerance in Surface and Ride Quality.**

1. **Surface Tolerance.** After the concrete has hardened sufficiently, the pavement surface shall be tested with a 10-foot straightedge. The surface tolerance shall be based on the posted speed limit as follows:

   a. In areas where the posted speed limit is 40 mph or greater, high spots of more than 1/8 inch but not exceeding 1/2 inch in 10 feet shall be ground with diamond grinding equipment to an elevation where the deviation is less than 1/8 inch. When the deviation exceeds 1/2 inch the area shall be ground with diamond grinding equipment or the pavement shall be removed and replaced at the Contractor's expense.

   b. In areas where the posted speed limit is less than 40 mph, high spots of more than 1/4 inch but not exceeding 5/8 inch in 10 feet shall be ground with diamond grinding equipment to an elevation where the deviation is less than 1/4 inch. When the deviation exceeds 5/8 inch the area shall be ground with diamond grinding equipment to the specified 1/4 inch deviation or the pavement shall be removed and replaced at the Contractor's expense.

   If corrective grinding is required and more than 1/2 inch of concrete is removed from any area ground, the area shall be cored. If the core is deficient in

length, the unit price for the deficient area will be adjusted according to Section 550.06 A.

If an area of pavement is removed, it shall be at least 6 feet in length and at least the full width of the lane involved. If the limits of removal extend to within 6 feet of a transverse joint, the pavement shall be removed to that joint. The Contractor shall repair the area as directed by the Engineer, including installing dowel bars at each end of the repair.

For pavement constructed by the slip-form method, the edge settlement shall be determined as soon as practical after paving operations begin. Any edge settlement in excess of 3/8 inch shall be corrected before the concrete has hardened. When edge settlements in excess of 1/4 inch persist, paving shall be suspended and operational corrections made before resuming paving operations.

2. **Riding Quality.**

Surface smoothness will be determined for all mainline pavement where the posted speed limit exceeds 40 mph. Mainline pavement is defined as all traffic lanes excluding acceleration lanes, deceleration lanes, tapered sections, widening, and shoulders. The profile will be terminated 20 feet from each bridge and 20 feet from existing pavement which is joined by the new pavement.

The Portland Cement Concrete pavement shall be placed and finished to produce a surface with a profile of 0.5 inch or less per 0.1 mile. Pavement smoothness and riding quality will be determined by a California Profilograph. The profile will be taken on 2 lines, 8 feet left and right and parallel to the centerline of the mainline pavement. Added profiles may be taken to define limits of an out-of-tolerance surface.

Computerized profilographs must use a third-order Butterworth filter with a cutoff wavelength of 2.0 feet. The computer shall generate a profile index using a 0.2 inch blanking band and use a 0.3 inch bump threshold to identify “must grind” locations. Each profilogram trace shall show blanking band, data filtering, must grinds, stationing, project number, lane, date tested and operator’s name. Profilogram traces shall be taken in the same direction as the paver and at a speed no greater than a normal walk. The manufacturer’s operator’s manual shall be used for calibration and operating instructions.

All areas represented by high points having deviations in excess of 0.3 inch in 25 feet or less shall be ground with diamond grinding equipment at the Contractor’s expense. Diamond grinding shall be conducted for a minimum of one 12-foot lane and one panel length. On pavement sections where corrections are necessary, second profilograph runs will be performed to verify that corrections have produced a Profile Index of 0.9 inch or less per 0.1 mile. If the initial Profile Index is less than 0.5 inch per 0.1 mile, only the areas representing 0.3-inch deviations will be reprofiled for correction verification. All corrective work shall be completed before determining pavement thickness.

If corrective grinding is required and more than 1/2 inch of concrete is removed from any area ground, the area shall be cored. If the core is deficient in

length, the unit price for the deficient area will be adjusted according to Section 550.06 A.

3. **Grinding.** Grinding and texturing shall be completed utilizing diamond blades, mounted on a self-propelled machine, designed for grinding and texturing of pavements. The equipment shall not cause strain or damage to the underlying surface of the pavement. Grinding and texturing equipment that causes excessive ravels, aggregate fractures, spalling, or disturbance of the joints shall not be permitted.

   Grinding shall be performed in the longitudinal direction so grinding begins and ends at lines normal to the pavement centerline. The maximum allowable overlap between passes shall be 2 inches and the maximum allowable depth variance between adjacent passes shall be 1/8 inch. The pavement shall be ground and textured until the pavement surface meets the riding quality specified in Section 550.04 P.2. The grinding shall be feathered out as directed by the Engineer.

   The surface of the ground pavement shall have a texture consisting of grooves between .090 and .130 inches wide. The peaks of the ridges shall be approximately 1/32 inch higher than the bottom of the grooves.

   High shoulders shall be ground to provide drainage and safety.

   The pavement shall be left in a clean condition. The removal of all slurry or residue resulting from the grinding operation shall be continuous. The grinding operation should be controlled so the residue from the operation does not flow across lanes utilized by traffic.

4. **Pay Adjustment.** When the average Profile Index does not exceed 0.5 inch but is greater than or equal to 0.3 inch per 0.1 mile, payment will be made at the Contract Unit Price for the completed pavement. When the average Profile Index is less than 0.3 inch per 0.1 mile, an incentive payment will be made for the completed pavement. When the average Profile Index exceeds 0.5 inch per 0.1 mile but does not exceed 0.9 inch per 0.1 mile, the Contractor may accept a Contract Unit Price adjustment in lieu of reducing the Profile Index. Contract Unit Price adjustments will be made according to the following schedule in those cases where the Contractor elects not to grind. Price adjustments for pavement that has been ground to reduce the Profile Index will be according to the following schedule, except no bonus will be paid.

| **Profile Index Inches Per 0.1 Mile** | **Contract Unit Price Adjustment** |
|---|---|
| Less than .30 | $0.50/square yard bonus(a) |
| .30 to .50 | Contract Unit Bid Price |
| .51 to .70 | $1.00/square yard deducted(b) |
| .71 to .80 | $2.00/square yard deducted(b) |
| .81 to .90 | $3.00/square yard deducted(b) |
| Over .90 | Corrective work required |

   a. Unit bid price adjustment will be paid only when both adjacent 12-foot driving lanes meet the indicated surface smoothness. To qualify for bonus

payment, each lane must have a measured profile index of less that 0.30 inches per 1/10 (0.1) mile for five or more consecutive 0.1 mile increments. A length of 25 feet on each side of each transverse construction joint (header) will be exempted from this requirement. The bonus payment will apply to the total area of the 1/2 (0.5) mile or more segment (two lanes, 24 feet wide) minus the exempted areas at the headers. No bonus will be paid in any segment if there is any grinding outside of the exempted areas.

If a header exemption area has a deviation in excess of 0.3 inch per 25 feet, the Contractor shall remove the high points with a diamond grinding device.

b. Unit bid price adjustment will apply to the total area of the 0.1-mile segment of pavement, for the lane width represented by the profile (12 feet wide). A paving section less than 0.1 mile shall be added to the subsequent day's paving operation to total 0.1 mile.

Payment for any pavement which has an average Profile Index greater than 0.9 inch per 0.1 mile will be made at Contract Unit Price minus $4.00/square yard until corrective work has been completed and the pavement reprofiled to verify a reduction in the average Profile Index to 0.9 inch or less.

Q. **Tolerance in Pavement Thickness and Reinforcing Steel.**

1. **General.** Pavement shall be constructed to the specified thickness. Before final acceptance of the work, the pavement will be cored by the Department, and the pavement thickness determined by measuring the cores according to AASHTO T-148. Pavement which is deficient in thickness by more than 0.2 inch shall be subject to adjustments in Contract Unit Price as provided in Section 550.06 A. Areas of pavement deficient in thickness by more than one inch shall be removed and replaced.

2. **Pavement Units.** When adjustments in Contract Unit Price are required due to deficient pavement thickness, the pavement will be divided into units as follows:

Main-line pavement of each specified thickness and of each separate pour width will be divided into basic units of 4,000 square yards each. The remaining fractional area adjacent to the end of each main-line pour width will be considered as a separate unit if the fractional area exceeds 1,000 square yards, or will be included in the adjacent basic unit if the area does not exceed 1,000 square yards.

An individual ramp, cross-over, intersection, shoulders, or other irregular area of pavement not included in the main line will be considered as separate 4,000 square yard units for determination of pavement thickness. The Engineer will determine which irregular areas will be cored.

3. **Determination of Pavement Thickness.** Cores to determine pavement thickness shall be taken after the grinding has been done. The random core samples may or may not fall at a grinding location. At least one core will be taken at random for each pavement unit. If the initial random core is deficient in

length by less than 0.2 inch from the specified pavement thickness, no additional cores will be required from that unit. When the initial random core is deficient in length by 0.2 inch and less than one inch, 2 additional random cores will be taken from the unit at intervals separated from each other and from the first core by at least 1/4 the length of the unit. If neither of the 2 additional cores are deficient in length by more than one inch, the average thickness of that unit of pavement will be computed as the average length of the 3 cores. In calculating the average pavement thickness, any core having a length in excess of the specified pavement thickness by more than 0.5 inch will be considered as having the specified length plus 0.5 inch.

When the length of any random core is less than the specified pavement thickness by more than one inch, exploratory cores will be taken at not less than 10-foot intervals parallel to the centerline in each direction from the random core until, in each direction, an exploratory core is obtained which is not deficient in length by more than one inch. The area of pavement found deficient in thickness by more than one inch will include the monolithic pour width of the lane or lanes and a length equal to the distance between points located midway between the last 2 cores at each end of the deficient section. The average thickness of the remainder of the unit will be determined from at least 2 random cores obtained outside the area that is deficient by more than one inch. Exploratory cores will not be used in computing average thickness for determining adjusted unit price.

4. **Reinforcing Steel Placement.** The tie bars final position shall be within the following tolerances:

Vertical Placement - ±1 inch

Transverse Placement - ±3 inches

The location of the tie bars under the longitudinal joints will be randomly checked twice a day to assure that their location is within the allowable tolerances. Failure to acquire the correct tie bar location shall require supporting the tie bars on chairs.

Vertical location of the reinforcement will be determined from the cores taken for determining pavement thickness and strength. Depth of the reinforcement below the top surface of the core will be determined from the average depth of the exposed steel members on the vertical surface of the core. Where 2 layers of reinforcement are evident in the core, each layer will be considered separately. All measurements will be made from the top surface of the core to the center of the exposed member, or if the member has been dislodged, to the center of the groove remaining on the vertical surface of the core.

When the average vertical location of the reinforcement in a pavement unit (as defined in Section 550.04 Q.2) is not more than 1/2 inch outside of the specified tolerance, a deduction of 10% of the price bid for concrete pavement in that pavement unit will be made. When the average vertical location of the reinforcement is more than 1/2 inch and less than one inch outside the specified tolerance, a deduction of 20% of the price bid for concrete pavement in that pavement unit will be made. No additional cores will be drilled

for these determinations. When the average vertical location of the reinforcement is 1 inch or more outside the specified tolerance or the reinforcement is less than 2 inches from the top or bottom of the pavement slab, a determination of serviceability will be made according to Section 105.07.

R. **Operational Limits.** Operational limits shall be as specified in Section 602.03 G.

## 550.05 METHOD OF MEASUREMENT.

A. **Concrete Pavement.** This item will be measured by the Square Yard according to Section 109.01. The pay quantity shall be the measured number of Square Yards of pavement complete, in place, and accepted. Separate measurement will be made of each type of concrete pavement, or high-early strength concrete pavement, for which separate payment is provided.

B. **Portland Cement.** When separate payment is provided for Portland Cement used in concrete pavement, the cement will be measured by the Ton. The pay quantity of Portland Cement shall be the number of tons used as authorized in the concrete pavement and in integral curb or other items placed monolithically with the pavement. Cement used for items not poured monolithically with the pavement, cement used according to Section 802.01 C.2.a, and cement which is lost or wasted will not be included in the quantity measured for payment. No deduction will be made for cement used in pavement exceeding Plan thickness. The pay quantity of Portland Cement will be computed on the basis of batch weights and number of batches used as authorized, except that the pay quantity shall not exceed the total tons of cement shipped in for the Project, less any cement not measured for payment as provided above.

C. **Pavement Reinforcement.** When separate payment is provided for reinforcement used in concrete pavement, the reinforcement will be measured as follows:

1. **Steel Fabric.** Welded Steel Wire Fabric of each style required by the Contract will be measured separately by the area of concrete pavement in which that style of fabric is incorporated, with no allowance for laps or material not used. The pay quantity of Steel Fabric will be the actual number of Square Yards of pavement in which a single layer of Steel Fabric is required or twice the actual number of Square Yards of pavement where 2 layers of fabric are required. No deduction in the area of fabric will be made for the required clearance adjacent to the edges of the slab and joints or for fixtures having a surface area of 9 square feet or less within the limits of the pavement. According to Section 550.04 Q.4, all areas of Steel Fabric determined as not meeting the specified requirements for vertical locations will be deducted from the fabric pay quantities. Where Reinforcement Bars are permitted in lieu of Steel Fabric and no bid item is provided for the bar steel, measurement of the reinforcement will be made on the basis that the Steel Fabric specified is used.

2. **Reinforcement Bars.** Bar Steel Reinforcement for concrete pavement (not including dowels, tie bars, or supporting devices) will be measured by the Pound, based on the theoretical weights of bars as listed in Section 612.04, and with no allowance for laps. When Reinforcement Bars of greater section area than required are permitted and used, measurement will be based on bar

sizes specified. According to Section 550.04 Q.4, the weight of all Bar Reinforcement determined as not meeting specified requirements for vertical location will be deducted from the pay quantities of the reinforcement. Where Steel Fabric is permitted in lieu of Reinforcement Bars and no bid item is provided for the Steel Fabric, measurement will be made on the basis that bar reinforcement is used.

D. **Doweled Joint Assemblies.** When separate payment is made for Doweled Expansion or Contraction Joint Assemblies, the joint assemblies will be measured by the Linear Foot. The pay length will be equal to the width of pavement in which the joint assembly is installed.

E. **Integral Curb.** When separate payment is made for Integral Curb, measurement of the curb will be based on horizontal dimensions. The pay quantity shall be the Linear Feet of Integral Curb in place.

F. **Preformed Elastomeric Compression Joint Seal.** Preformed Elastomeric Compression Joint Seal will be measured by the Linear Foot of joint in which the seal is installed.

G. **Longitudinal Shoulder Joints.** This joint will be measured by the Linear Foot of completed joint.

H. **Fly Ash.** Fly Ash will be measured as provided for Portland Cement.

**550.06 BASIS OF PAYMENT.**

A. **Concrete Pavement.** The accepted quantities of concrete pavement will be paid for at the Contract Unit Price bid per Square Yard, except any pavement found deficient in thickness by more than 0.2 inch but not more than one inch when determined according to Section 550.04 Q will be paid for at an adjusted unit price as specified in the following table:

| Deficiency in Pavement Thickness (Inches) | Deduction of Contract Unit Price |
|---|---|
| 0 to 0.2 | 0% |
| Over 0.2 to 0.3 | 10% |
| Over 0.3 to 0.5 | 20% |
| Over 0.5 to 0.6 | 30% |
| Over 0.6 to 0.7 | 40% |
| Over 0.7 to 1.0 | 50% |

If cement, flyash, aggregates, or other concrete components are bid separately, their costs will be added to the Contract Unit Price per Square Yard of concrete pavement before calculating the price deductions for the pavement deficient in thickness.

When the pavement thickness is deficient by more than one inch, and the Engineer determines the deficient area should not be removed and replaced, based on structural and serviceability criteria, there will be no payment for the area retained. No payment exceeding the Contract Unit Price will be made for any pavement which has an average thickness in excess of that specified.

The payment for concrete pavement or high early strength concrete pavement shall include all work and items involved in construction of pavement such as Portland Cement, fly ash, steel reinforcement, tie bars, joint sealants, curing materials, etc. Payment will be made at the Contract Unit Price for the following:

| **Pay Item** | **Pay Unit** |
|---|---|
| Non-Reinforced Concrete Pavement | Square Yard |
| Reinforced Concrete Pavement | Square Yard |
| Non-Reinforced Concrete Pavement (HES) | Square Yard |
| Reinforced Concrete Pavement (HES) | Square Yard |
| Continuously Reinforced Concrete Pavement | Square Yard |

B. **Miscellaneous Items.** When shown on the Plans, payment will be made at the Contract Unit Price for the following:

| **Pay Item** | **Pay Unit** |
|---|---|
| Portland Cement, Type ____ | Ton or Cwt. |
| Fly Ash | Ton |
| Steel Fabric, ____ | Square Yard |
| Reinforcement Bars | Pound |
| Doweled Expansion Joint Assembly | Linear Foot |
| Doweled Contraction Joint Assembly | Linear Foot |
| Integral Curb | Linear Foot |
| Preformed Elastomeric Compression Joint Seal | Linear Foot |
| Longitudinal Shoulder Joint | Linear Foot |
| Continuous Rumble Strip | Mile |

This payment will be full compensation for all labor, equipment, and materials necessary to complete the work.

# SECTION 560
# RECYCLED PORTLAND CEMENT CONCRETE PAVEMENT

## 560.01 DESCRIPTION.

This work consists of removing, crushing, screening, and stockpiling Portland Cement Concrete pavement into the required gradation, and adding new materials to produce and place a Portland Cement Concrete pavement. Section 550 will be applied in conjunction with this Section.

## 560.02 MATERIALS.

Materials shall meet Sections 550 and 802.